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JUNIOR HIGH MATHEMATICS

PROGRAM OF STUDIES

This is an **interim** program of studies for the junior high mathematics program. This program is scheduled for mandatory implementation in **September 1988**.

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MATHEMATICS

A. PROGRAM RATIONALE AND PHILOSOPHY

Mathematics is an important component of education because it enables citizens to lead useful and productive lives and to be adaptive in an ever-changing technological society. The study of mathematics leads to a better understanding and appreciation of the quantitative and geometric nature of the concrete world and to the development of the knowledge, skills and positive attitudes necessary for decision making in personal living. All students should receive a level of mathematics education appropriate to their needs and abilities.

A mathematics program must provide a balance between a knowledge base and the application of that knowledge, especially in new situations and with new technologies. The pervasiveness of calculators and microcomputers and the increasing reliance of the economy on information transfer and processing have changed the ways in which mathematics is used in our society. The result is a substantial (and ongoing) change in emphasis within the familiar mathematical topics such as computational facility, problem solving, measurement and geometry.

The development of positive attitudes toward mathematics and learning is an essential element of a mathematics program in that it nurtures the confidence necessary for taking risks, accepting challenges and making decisions. Positive attitudes are generated by making mathematics meaningful and relevant to students, by selecting activities that are appropriate to students' abilities and by providing opportunities for students to experience success.

Each student must be viewed holistically and as capable of learning. Since self-concept influences learning and achievement, the program should encourage in each student a positive self-concept, and should focus on the growth of each individual. Appropriate and varying organizational and instructional strategies should be implemented to meet the diverse and individual needs of students.

Although junior high school students are at various stages of physical, emotional, and cognitive development, they all require experiences at a concrete level. Extensive experiences with concrete representations of mathematical concepts lead to intuitive understandings of abstractions. Students should be carefully guided from the concrete (model), through the transitional (pictorial representation) and eventually on to the formal (symbolic) level of cognition as mathematics concepts are being developed.

Junior high school students are in a transitional stage of life. Adolescence, characterized by rapid physical growth and the onset of puberty, is a period of uncertainty and great concern about peer relationships. The physical, intellectual, emotional, and social development of the students vary greatly. Supportive comments and guidance, and a genuine expression of concern for students, can help to maintain meaningful communication with students and enhance their learning.

The aim of the Junior High Mathematics Program is to develop an understanding of mathematics concepts by making mathematics relevant and concrete. The emphasis within the program must reflect the reality of the technological age. Appropriate experiences presented in a logical sequence will result in positive attitudes and positive learning outcomes.

B. GOALS AND OBJECTIVES

The goals of the Junior High Mathematics Program are to enable students to:

- solve problems and to grow in their capability to deal with new or different situations.
- use mathematics as a tool in the pursuit of personal goals and aspirations.
- develop a positive self-concept and a positive attitude toward mathematics and lifelong learning.

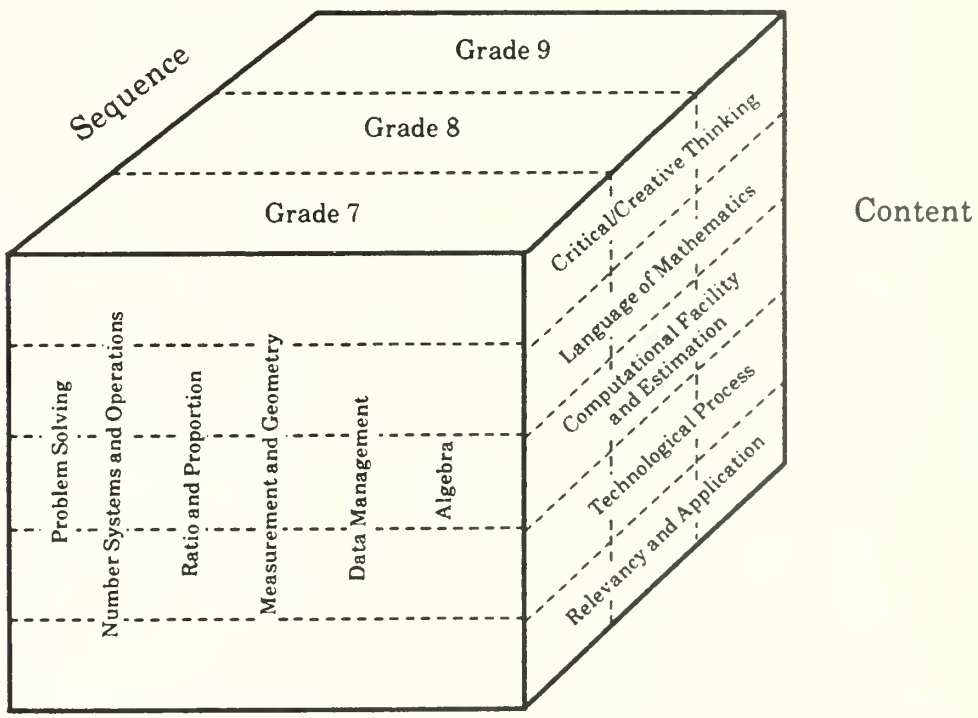
C. CONTENT

STRUCTURE OF THE PROGRAM

The content of the Junior High Mathematics Program is divided into six strands: problem solving; number systems and operations; ratio and proportion; measurement and geometry; data management; and algebra. The content is a consolidation of the skills and concepts developed in the elementary program and forms the basis for the further study of mathematics at the senior high school level. The skills and concepts within these strands are carefully sequenced over three grades taking into account the developmental nature of mathematics and the developmental nature of the learner. All students enrolled in this program should have an opportunity to complete it successfully.

There is an implicit dimension of the mathematics program that transcends the scope and sequence. It cannot be discretely taught as a unit of study nor can it be found in a chapter of a textbook. The context of the program is the element of teaching that creates and fosters positive attitudes, builds appropriate mindsets, and helps the learner interpret and understand the environment in relation to mathematics. Critical and creative thinking, the acquisition of quantitative concepts and skills (number sense), knowledge about and willingness to use technology, knowledge of the language and history of mathematics and the meaningfulness and relevancy of mathematics, must be modelled on a continuous basis and must be integrated into all strands of the program.

JUNIOR HIGH MATHEMATICS
PROGRAM DIMENSIONS



The teacher can model and integrate these aspects of the mathematics program through his or her mediation or explanation to students. Understandings are learned, modified and refined over time, eventually building conceptions similar to what the teacher has in mind. The teacher observes students at a task and actively refines their understanding until the desired learning outcome is obtained. Teachers help students interpret these tasks by what they say about them (or by what they leave unsaid). For example, teachers who talk about the perplexing nature of problem solving are likely to impart to students the understanding that perplexity is a normal state in solving problems.

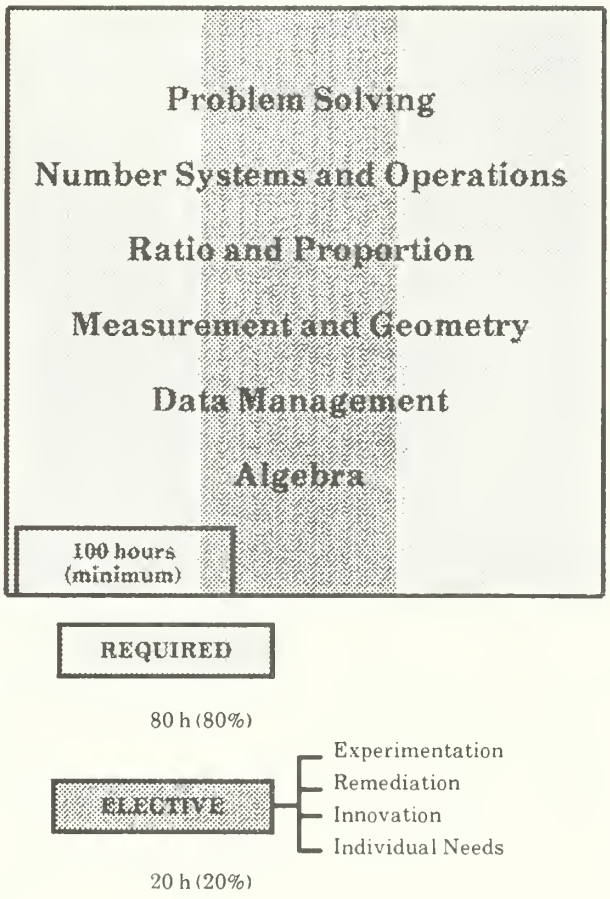
Student understandings and learning outcomes may not always be what teachers intend. For example, when students are always given busy work on computation, the understanding that they may develop is that "getting done" is more important than learning to compute. Students construct understandings about what is important, what to pay attention to and how to behave, from their own experiences and from tasks they encounter within the school experience. New experiences and tasks are combined with old understandings to build new understandings and conceptions.

REQUIRED–ELECTIVE FORMAT

The Junior High Mathematics Program has two components. The required component of the course outlined by the scope of the program describes the basic skills, knowledge and attitudes that all students should be expected to acquire. Of the 100-hour **minimum requirement** for the program, 80% (or 80 hours) shall be spent on this element of the course.

The elective component of the program shall be used to adapt and enhance the required portion of the course to meet the diverse and individual needs and capabilities of individual students. The activities associated with the elective must be integrated throughout the required component and shall be used to remediate and enrich student learning and/or to innovate and experiment with varying instructional and organizational strategies that may enhance student learning. The elective component is not intended to provide acceleration or advanced placement and therefore avoids unnecessary overlap with other courses or courses at a higher level. The maximum time allotment for the elective component shall be 20% of the instructional time.

In cases where the time allotted to the Junior High Mathematics Program exceeds the 100-hour minimum requirement, additional content may be presented to all the students. This content should extend and enhance the understanding of the knowledge, skills and attitudes in the required portion of the program.



SCOPE OF THE PROGRAM

i. Problem Solving

The most important goal of mathematics instruction is the development of students' ability to solve problems. The emphasis on problem solving requires a change in focus from exclusively finding answers to routine word problems to the acquisition and application of many different skills and strategies. Students should be able to apply these strategies to a variety of problem situations where the solutions are unknown and the means to the solution are not immediately evident.

Although problem solving is a legitimate goal in its own right, it should not be viewed as an isolated activity but, rather, as a group of related skills that are a part of a mathematics program. Because of the emphasis it must receive, problem solving appears both as a strand in the program and in an integrated form. The stages of problem solving and a variety of specific skills and strategies are identified and then developed within the strand. The skills, strategies and attitudes associated with problem solving are integrated into the rest of the program and should become part of the teaching philosophy.

ii. Number Systems and Operations

Quantitative thinking and understanding and computational facility are still important goals of mathematics instruction. However, there must be a recognition that there are several ways to compute and today's students must be adept at all the methods. Students must be able to decide which method is most appropriate to the situation at hand and what degree of precision and accuracy is required.

Mental computation, paper-and-pencil operations, estimation and the use of calculators and/or microcomputers are computational strategies that must replace the singular emphasis on paper-and-pencil facility. Paper-and-pencil drills on arithmetic operations with more than three-digit numbers must be de-emphasized. Facility with one-digit number facts must be maintained. Activities that develop number sense and demonstrate the utility of mathematics in problem-solving situations shall increase in emphasis.

Working with numbers and number operations in a real world, problem-solving context gives meaning to numbers and to the operations with them. This is especially true of fractions and decimals. Emphasis shall be placed on the understanding of fractions and decimals as numbers and the comparisons of, and conversions between, fractions and decimals. Drill on operations of fractions with large denominators or multi-place decimals should be de-emphasized.

Mental computation involves finding natural and easy (not formal and algorithmic) strategies for calculations and results in an understanding of number relationships that cannot be replaced by technology. An understanding of the basic properties of number operations shall be developed for the purpose of doing mental calculations.

A heavy emphasis shall be placed on estimating measures and computations (including those that appear in complicated forms). Estimation requires a feel for numbers that goes beyond formal round-off procedures. Students must develop an estimation mindset that includes knowing what an estimate is, accepting its legitimacy, sensing when it is appropriate to estimate, recognizing how precise an estimate should be for a given situation and when a computed answer is sensible.

iii. Ratio and Proportion

Ratio and proportion concepts, although they are an extension of the number systems and operations strand, have been collectively identified as a strand for the purpose of emphasis. The importance and use of equivalent representations in areas such as comparative shopping, scale drawings, model building, map reading, calculating wages, understanding and computing percents, and problem solving, as well as in the study of pure mathematics, cannot be over emphasized. A basic understanding of ratio and proportion must be developed at a concrete level. The applications of ratio and proportion, and percent are numerous and should be made meaningful and relevant to students.

iv. Measurement and Geometry

SI metric measurement concepts and skills need to be consolidated in junior high school. Concrete experiences with making direct comparisons of objects with arbitrary units (e.g., the hand) and with standard units of length, area, volume, capacity and mass (e.g., cm, km^2, m^3, L, g) shall be provided. The need for large and small units of measure and the need to subdivide units into fractional parts should be emphasized. Formulas must be treated as useful tools for finding indirect measurements (e.g., speed) and for finding measurements indirectly (e.g., area). They shall be used after students understand the measure they are to calculate. Excessive memorization of formulas is discouraged.

Geometry is the study of the attributes and properties of various shapes and objects. Attributes to be considered are size and shape of one-, two-, and three-dimensional objects and the transformations of one- and two-dimensional shapes. The measurement of geometric attributes is best done in the context of measurement.

v. Data Management

People are confronted daily with data from which they must make personal and career decisions. Students must cope effectively with the vast amounts of data that they encounter. The importance of statistics, techniques for collecting and interpreting data, making predictions from data and techniques for organizing and displaying data will constitute this strand.

vi. Algebra

Algebra and algebraic thinking are not restricted to courses in the high school. From the time students enter school, they learn about generalizations in the form of symbolism, relations and functions. Open sentences ($\square + 2 = 8$) are used to express basic addition facts; ordered pairs are learned as a part of language development (associating a name with an object); relationships among numbers are learned through counting (less than, equal to, or greater than); and functions which have a unique ordered pair, given the first number, are used in learning basic number facts (e.g., in learning the three-times multiplication table, the set of answers 3, 6, 9... are a function of the counting numbers 1, 2, 3...). Graphs are pictorial representations of the relationship between unique pairs of numbers (e.g., heights of students plotted versus age of students).

THE ROLE OF CALCULATORS AND COMPUTERS

The rapid growth of microtechnology has had an immense impact on mathematics education. Standard computations and manipulations of algebraic symbols, for example, are now incidental applications of hand-held calculators. Mathematics programs must recognize the pervasiveness of technology by de-emphasizing activities that are much more easily replicated by computers, calculators and, in the future, by as yet unknown technologies. Emphasis must be placed on problem solving and on understanding concepts and relationships. Technologies such as computers and calculators must be used to develop concepts, to explore relationships, to explore patterns, to organize and display data, and to eliminate tedious computations.

COURSE OUTLINE

GRADE 7

Problem Solving

1. Demonstrates an understanding of a problem-solving situation.

2. Demonstrates a willingness to find a solution to a problem.

3. Uses a variety of strategies to solve problems.

   The following strategies should be developed throughout the various strands of the program and within the problem-solving framework:

   a. Understanding the problem
   - knows the meaning of all the words in the problem
   - identifies key words
   - draws a diagram
   - classifies information as insufficient or extraneous
   - restates the problem in own words
   - uses concrete manipulatives
   - looks for a pattern
   - considers an alternative interpretation

   b. Developing a plan (choosing a strategy)
   - guesses and checks - improves the guess
   - chooses and sequences mathematical operations
   - acts out or simulates the problem
   - applies a pattern
   - uses a simpler problem

   c. Carrying out the plan
   - applies selected strategies
   - presents ideas clearly
   - documents the process
   - works with care
   - works in a group situation

   d. Looking back
   - determines if the answer is reasonable
   - explains the answer in oral and written form
   - states the solution to the problem
   - restates the problem with the answer
   - considers other possible solutions to the problem
   - looks for other ways to solve the problem
   - discusses solution process with others

Number Systems and Operations

1. Applies and practises problem-solving skills in new situations.

2. Uses mental computation, paper-and-pencil algorithms, estimation and calculators to perform computations.

A. Whole Numbers

1. Maintains previously developed skills with whole numbers (place value, standard and expanded forms, adding, subtracting, multiplying and dividing whole numbers).
2. Understands properties of number operations and uses properties and relationships to perform mental computations (e.g., associative, commutative, distributive).
3. Understands that division by zero is undefined.
4. Writes the value of a power (whole number base and exponent).
5. Applies the rules for the order of operations to evaluate expressions.
6. Recognizes prime numbers (limit: primes to 50).
7. Lists the set of factors for whole numbers up to 200.
8. Expresses a number as a product of its prime factors.
9. Uses a calculator or microcomputer to generate a set of multiples of a given number.
10. Determines whether a number is divisible by 2, 3, 5, 6, 9 or 10.

B. Decimals

1. Maintains previously developed skills with decimal numbers (place value, expanded and standard forms, adding, subtracting, multiplying and dividing decimal numbers).
2. Compares and orders decimal numbers.
3. Rounds decimal numbers.

C. Fractions

1. Maintains previously developed skills with fractions (concept of a fraction, need for fractional numbers, equivalent fractions, basic fractions) at a concrete level.
2. Identifies mixed numbers and improper fractions and converts from one to the other.
3. Orders fractional numbers.
4. Uses concrete manipulatives to demonstrate the addition and subtraction of fractions with and without common denominators.
5. Writes number sentences to describe the addition and subtraction of fractions.
6. Uses concrete manipulatives to demonstrate the multiplication and division of proper fractions.
7. Writes number sentences to describe the multiplication and division of fractions.

D. Integers

1. Maintains previously developed skills with integers (concept of integers, need for integers, ordering of integers).
2. Uses concrete manipulatives to demonstrate the addition of integers.
3. Writes number sentences to describe addition of integers.

Ratio and Proportion

1. Applies and practises problem-solving skills in new situations.

2. Maintains previously developed skills (identifies ratios as ordered pairs of numbers related to concrete situations; uses whole number constants to generate equivalent ratios).

3. Uses concrete manipulatives to construct ratios in the following forms:

$$a{:}b,\ a \text{ as to } b, \text{ and } \frac{a}{b}$$

4. Verifies the equivalence of two ratios using common multiples or factors:

$$\text{e.g.,}\quad \begin{array}{ll} \underline{14} & (\div 2) \rightarrow \underline{7} \\ 6 & (\div 2) \rightarrow 3 \end{array}$$

5. Finds a missing element of a proportion using a common multiple of the elements:

$$\text{e.g.,}\ \begin{array}{ll} \underline{3} & (\times 3) \rightarrow \underline{x} \\ 4 & (\times 3) \rightarrow 12 \end{array}$$

6. Identifies percent as a ratio:

$$\text{e.g.,}\left(p{:}100 \text{ or } \frac{p}{100}\right)$$

7. Expresses ratios as percents and decimals and vice versa (limit: ratios in the form a:b, where b = 2, 4, 5, 10, 20, 25, 50):

$$\text{e.g.,}\ \frac{3}{4} \rightleftharpoons \frac{75}{100} \rightleftharpoons 75\%$$

8. Finds the percent of a number:

e.g., 15% of 25

9. Expresses one number as a percent of another number:

e.g., 12 is what percent of 16?

$$\text{or } \frac{12}{16} = \underline{\quad\quad}\%$$

Measurement and Geometry

1. Applies and practises problem-solving skills in new situations.

2. Maintains previously developed skills (concepts of linear, perimeter, area, volume, capacity and mass measures in concrete, pictorial and formal forms; determines perimeter and area of right triangles and rectangles, and volumes of rectangular solids with and without formulas; uses protractor to determine the measure of an angle; transformational geometry).

3. Expresses equivalent measures of SI units (linear).

4. Understands and uses the terms similar and congruent with respect to geometric figures.

5. Understands and uses the term symmetry with respect to geometric shapes.

6. Constructs geometric designs using tools such as a computer, compass, straightedge, ruler or mira.

Data Management

1. Applies and practises problem-solving skills in new situations.

2. Demonstrates a knowledge and understanding of the use and purposes of statistics as it affects daily living.

3. Collects and records data (tally sheets and frequency tables).

4. Understands and uses the term average (mean) as related to practical situations (e.g., test marks).

5. Interprets data from pictographs, bar graphs, line graphs and circle graphs.

6. Understands when and how to represent data in the form of pictographs, bar graphs, line graphs and circle graphs.

Algebra

1. Applies and practises problem-solving skills in new situations.

2. Understands and uses the term variable and uses variables to describe a concrete situation (e.g., number of jelly beans in a jar).

3. Uses variables to write mathematical expressions to represent practical situations (e.g., age of the students in the class in three years will be x + 3 years).

4. Evaluates expressions for given values of the variable (limit: whole numbers, positive rationals).

5. Uses variables to write mathematical sentences to represent practical situations (e.g., people in a classroom = boys + girls + teachers or p = b + g + t).

6. Uses concrete manipulatives to demonstrate the concept of "equals" (i.e., equality).

7. Uses estimation, and guess and test procedures to solve equations of the form:

$$x+a=b,\ ax=b,\ ax+b=c, \text{ and } \frac{x}{a}=\frac{b}{c}$$

8. Verifies solutions to equations by substitution.

9. Given ordered pairs, plot points on a coordinate plane.

GRADE 8

Problem Solving

1. Demonstrates an understanding of a problem-solving situation.

2. Demonstrates a willingness to find a solution to a problem.

3. Uses a variety of strategies to solve problems. Previously developed strategies are used.

   The following strategies should be developed throughout the various strands of the program and within the problem-solving framework:

   a. **Understanding the problem**
      - interprets pictures, charts and graphs
      - asks relevant questions

   b. **Developing a plan (choosing a strategy)**
      - collects and organizes information (charts and graphs)
      - makes diagrams and models
      - experiments through the use of manipulatives
      - breaks the problem into smaller parts
      - works backwards

   c. **Carrying out the plan**
      - applies selected strategies
      - presents ideas clearly
      - documents the process
      - works with care
      - works in a group situation

   d. **Looking back**
      - makes and solves similar problems

Number Systems and Operations

1. Applies and practises problem-solving skills in new situations.

2. Uses mental computation, paper-and-pencil algorithms, estimation and calculators to perform computations.

A. Whole Numbers

1. Maintains previously developed skills with whole numbers (operations, order of operations, evaluation of expressions, prime numbers, factorization, divisibility).

2. Finds the greatest common factor of a given set of numbers.

3. Finds the lowest common multiple of a given set of numbers.

4. Understands and uses the terms exponent, base, power, squared and cubed and the n^{th} power of a number.

5. Demonstrates the need for scientific notation.

6. Writes numbers in scientific notation, and scientific notation numbers in standard form (limit: positive exponents).

B. Integers

1. Maintains previously developed skills with integers (need for integers, concept of integers, ordering of integers, demonstrates addition of integers with manipulatives).

2. States the additive inverse of any integer.

3. Uses concrete manipulatives to demonstrate the subtraction, multiplication and division of integers.

4. Performs the operations of addition, subtraction, multiplication and division with integers using paper-and-pencil algorithms, estimation, mental computation and a calculator.

C. Rational Numbers

1. Maintains previously developed skills with decimal numbers (place value, operations, ordering, rounding, order of operations).

2. Maintains previously developed skills with fractional numbers (concept of a fraction, equivalent fraction, basic fraction, mixed numbers, improper fraction, ordering fractions, concrete operations with fractions, order of operations).

3. Writes the multiplicative inverse (reciprocal) of a fraction, whole number or integer.

4. Performs the operations of addition, subtraction, multiplication and division with fractions (limit: positive rationals).

5. Demonstrates the need for rational numbers (e.g., $-3 \div 2 = ?$ No answer is possible without a set of rational numbers).

6. Recognizes rational numbers as all numbers that can be written in the form:

   $\frac{a}{b}$ where $b \neq 0$.

7. Compares and orders rational numbers using $<$, $>$ or $=$.

8. Uses a number line to demonstrate the relationship between whole numbers, integers, fractions and rationals.

Ratio and Proportion

1. Applies and practises problem-solving skills in new situations.

2. Maintains previously developed skills (understands and constructs ratios, equivalent ratios; finds missing element of a proportion, percent as a ratio, percents as decimals, percents of numbers; and expresses one number as a percent of another).

3. Gives examples of ratios involving situations where the equivalent percent is greater than 100.

4. Converts mixed numbers to percents and vice versa.

5. Given the percent determines the missing value in applications such as discounts, increases, decreases, or sales tax.

6. Understands and writes rates as the comparison of two numbers with <u>different</u> units (e.g., 15 km/2h or 3 items/$1).

7. Writes proportions involving rates.

8. Finds the missing element in a proportion involving rates.

Measurement and Geometry

1. Applies and practises problem-solving skills in new situations.

2. Maintains previously developed skills (linear, area, volume, capacity and mass units of measure; uses geometric tools to measure line segments and angles and to construct geometric designs; transformational geometry).

3. Understands and uses the terms perpendicular and parallel lines.

4. Draws or sketches various polygons using tools such as a computer, compass, straightedge, ruler, protractor.

5. Identifies and classifies polygons according to the number of sides (limit: decagon).

6. Investigates triangles by examining attributes such as measure of angles, measure of sides and lines of symmetry.

7. Investigates quadrilaterals by examining attributes such as measure of sides, measure of angles, lines of symmetry and diagonals.

8. Adds, subtracts, multiplies and divides using SI units of measure.

9. Understands and uses formulas as indirect measures of the perimeter of polygons (includes regular polygons).

10. Understands and uses formulas as indirect measures of the area of polygons (triangles, all parallelograms and trapezoids).

11. Performs an experiment to determine the value of π and understands π as a ratio of the circumference of a circle divided by its diameter.

$$(i.e.,\ \pi = \frac{C}{d})$$

12. Understands and uses the formula $C = \pi d$ as an indirect measure of the circumference of a circle.

13. Uses the formula $A = \pi r^2$ to indirectly determine the area of a circle given its radius or diameter.

14. Draws or sketches a right rectangular prism.

15. Understands and uses a formula as an indirect strategy for determining the volume of a right rectangular prism or a cube.

Data Management

1. Applies and practises problem-solving skills in new situations.

2. Maintains previously developed skills (understands the purpose of statistics; interprets data from tables and graphs; draws graphs).

3. Understands and uses the terms bias, sample and population.

4. Distinguishes between a survey and a census, understands when each is used and potential biases that may occur (survey).

5. Recognizes the use and misuse of statistics in society (news reporting, census, polls, etc.).

Algebra

1. Applies and practises problem-solving skills in new situations.

2. Maintains previously developed skills (variable, evaluation of expressions, concept of equality, plots on a coordinate plane).

3. Identifies and combines like terms.

4. Uses formal procedures to solve equations of the form:

$$x + a = b,\ ax = b,\ ax + b = c,\ \text{and}\ \frac{x}{a} = \frac{b}{c}$$

(limit: positive rational numbers and integers).

5. Verifies solutions to the equations.

6. Uses substitution and equation-solving techniques to find a missing element of a formula:

$$\text{e.g., If } p = 2 \text{ and } q = 0.5 \text{ find } c \text{ in } p = \frac{c}{q}$$

7. Generates a set of ordered pairs in a linear relation.

8. Given a linear relation, constructs a table of values and a graph for that relation.

GRADE 9

Problem Solving

1. Demonstrates an understanding of a problem-solving situation.

2. Demonstrates a willingness to find a solution to a problem.

3. Uses a variety of strategies to solve problems. Previously developed strategies are used.

   The following strategies should be developed throughout the various strands of the program and within the problem-solving framework:

   a. **Understanding the problem**
      - considers alternative interpretations
      - makes assumptions

   b. **Developing a plan (choosing a strategy)**
      - formulates an equation
      - uses logic or reason
      - constructs flow charts
      - develops a symbol or code system
      - recognizes limits and eliminates possibilities

   c. **Carrying out the plan**
      - applies selected strategies
      - presents ideas clearly
      - documents the process
      - works with care
      - works in a group situation

   d. **Looking back**
      - generalizes solutions
      - creates and writes routine and non-routine problems

Number Systems and Operations

1. Applies and practises problem-solving skills in new situations.

2. Uses mental computation, paper-and-pencil algorithms, estimation and calculators to perform computations.

3. Maintains previously developed skills with whole numbers, integers, decimals and fractions (operations, ordering, relationships among systems, need for rational numbers, order of operations).

4. Performs the operations of addition, subtraction, multiplication and division with rational numbers.

5. Applies the rules for order of operations to evaluate expressions involving rational numbers in any of their forms.

6. Converts rational numbers from $\frac{"a"}{b}$ form to decimal form (limit: $b < 10$ or b is a power of 10).

7. Converts rational numbers from decimal form to $\frac{"a"}{b}$ form (limit: terminating decimals).

8. Computes the square root of whole numbers using estimation and a calculator.

9. Demonstrates the relationship among whole numbers, integers and rational numbers.

10. Understands and uses the following properties (limit: numerical bases):

    - $a^x \times a^y = a^{x+y}$
    - $a^x \div a^y = a^{x-y}$
    - $(a^x)^y = a^{xy}$
    - $a^1 = a$
    - $a^\circ = 1, a \neq 0$
    - $a^{-x} = \frac{1}{a^x}$ (limit: $a = 10$)

11. Writes large and small numbers in scientific notation:

    (e.g., $0.00008 = 8 \times 10^{-5}$)

Ratio and Proportion

1. Applies and practises problem-solving skills in new situations.

2. Maintains previously developed skills (understands and constructs ratios, rates and proportions; finds the missing element of a proportion; writes ratios as percents; converts fractions and decimals to percents and percents to fraction and decimal forms; finds missing values in commission, sales tax, and discount situations).

3. Converts fractional percents to fraction and decimal forms:

$$\text{e.g., } 12\tfrac{1}{2}\% = \frac{1}{8} = 0.125$$

4. Finds any one of the missing elements (value or percent) in applications such as simple interest, commission, sales tax, discount, profit and loss, and percent increase and decrease situations.

5. Interprets maps and scale drawings.

6. Uses a scale to construct drawings, maps or pictures.

7. Applies ratio and proportion in practical situations (e.g., uses shadows to find the height of a pole or building; comparative shopping; building a model, computing a test or report card mark based on weighted averages).

Measurement and Geometry

1. Applies and practises problem-solving skills in new situations.

2. Maintains previously developed skills (linear, area, volume, capacity, and mass units of measure; classification of polygons; perimeter and area of polygons and the circle; volume of a right rectangular prism and cube).

3. Uses concrete manipulatives to determine the sum of the angles in a triangle (180°).

4. Determines the sum of the interior angles in polygons.

5. Uses concrete manipulatives to develop the Pythagorean relationship in right triangles.

6. Applies the Pythagorean relationship to practical situations.

7. Constructs regular polygons using tools such as a computer, ruler, protractor and/or compass.

8. Understands and uses a strategy to determine the area of a regular polygon.

9. Identifies pairs of angles: (supplementary, complementary, adjacent and opposite).

10. Uses a compass and a straightedge to construct:
    - a congruent segment
    - a congruent angle
    - a perpendicular bisector of a segment
    - a bisector of an angle
    - a perpendicular to a line
    - angles of 90°, 45°, 60° and 30°.

11. Given nets, constructs right prisms.

12. Classifies right prisms and cylinders.

13. Understands and uses a strategy for finding the surface area of any right prism or cylinder.

14. Understands and uses a strategy for finding the volume of any right prism or cylinder.

Data Management

1. Applies and practises problem-solving skills in new situations.

2. Maintains previously developed skills (understands purpose, use and misuse of statistics; biases in surveys; represents data in the form of pictographs, bar graphs, line graphs, circle graphs).

3. Analyzes and interprets arguments or conclusions based on statistical information.

4. In data from meaningful situations (e.g., test marks), understands and uses the terms mean, median, mode and range.

5. Distinguishes between a percent and a percentile.

6. Conducts a survey or poll using correct sampling techniques and reports results using an appropriate table, chart and/or graph.

7. Understands and uses the term probability.

8. Expresses the probability of the occurrence of an event from a practical situation or a simple experiment or simulation (e.g., pulling a particular coloured marble out of a bag or socks out of a drawer).

Algebra

1. Applies and practises problem-solving skills in new situations.

2. Maintains previously developed skills (variables; like terms, evaluation of expressions; solving equations; generating and plotting ordered pairs from a given relation).

3. Uses formal procedures to solve equations (using all forms of rationals) of the form:

$$x+a=b,\ ax=b,\ ax+b=c, and\ \frac{x}{a}=\frac{b}{c}$$

$$ax+b=cx, a(x+b)=c$$

$$and\ ax+b=cx+d$$

4. Verifies solutions to equations.

5. Manipulates a given formula to change the subject of the formula:

$$\text{e.g., given } x=\frac{f}{w} \text{ then } w=\frac{f}{x}$$

6. Finds a missing element of a formula through manipulation.

7. Solves inequalities of the form $x + a \geq b$ and $cx \leq d$ (c is positive; direction of inequalities may vary).

8. Verifies solutions to inequalities.

9. Graphs solutions to inequalities on a number line.

10. Given a set of ordered pairs or a table of values, writes the function that determines the relation (limit: linear relations).

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For Reference

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